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YELLOW FEVER.

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Definition.—Yellow fever is a specific infectious disease in which one attack, as a rule, protects from subsequent attacks. The febrile paroxysm inaugurating an attack usually lasts from two to five days, and is followed by a period of great depression of the vital powers, during which there is a tendency to suppression of urine and to passive hemorrhage from mucous membranes. The urine contains albumin, the skin has a more or less pronounced icteric hue, and in fatal cases "black vomit" is usually ejected before death.

Etiology.—Yellow fever is not a contagious disease in the strict sense of the word—*i. e.* it is not usually contracted by contact with the sick—but, as in cholera and in typhoid fever, the infectious element multiplies in the body of the sick, and epidemics usually extend from foci of infection originating from the introduction of cases of the disease into localities previously free from it. Although not definitely demonstrated, it seems extremely probable that this occurs in the same way as in the diseases mentioned—viz. through the excreta. This is indicated by the fact that while contact with the sick as nurse or physician does not lead to infection, the soiled clothing and bedding of yellow fever patients may induce an attack in those who handle them, and may originate an epidemic when transported, without having been disinfected, to another locality. When yellow fever prevails as an epidemic, physicians and nurses are very liable to contract the disease because they are necessarily exposed in the infected localities, not because they come in contact with sick. This is an important fact which is established by abundant evidence, and yet it is denied by many physicians living in cities where the disease is endemic, who insist that the disease is transmitted by personal contagion. This opinion no doubt arises from the mistaken assumption that successive cases in the same house or neighborhood are directly connected in their etiology one with another, as commonly occurs in the strictly contagious diseases—*e. g.* smallpox or measles. On the contrary, they all contract the disease from a common and external source—the infected locality. It is well known that certain local and climatic conditions are essential for the development of the infectious agent ("germ") outside of the human body, and the consequent establishment of an external focus of infection and the epidemic prevalence of the disease. On the contrary, we have numerous observations which show that the introduction of cases or of fomites into localities where conditions are not favorable for the external multiplication of the infectious agent does not result in the occurrence of other cases in the vicinity, as would follow if the disease was propagated by personal contact. This is well illustrated in the city of Mexico, and at Petropolis, a health resort in the mountains a few hours' journey from Rio de Janeiro. Yellow fever is endemic at the sea-coast city of Vera Cruz, and during the summer months persons from the interior who visit this infected locality are very likely to contract yellow fever. Persons coming from the city of Mexico for a short visit on business or pleasure frequently fall sick with the disease after their return to their homes, but they never communicate it to those associated with them, and no focus of infection is developed as a result of their presence in the crowded and rather dirty capital city, which is located at an elevation above that at which the infectious agent is able to propagate itself outside of the body of the sick. The same is true as regards Petropolis, which is a health resort during the epidemic season for unacclimated persons residing in Rio de Janeiro. Communication between the two places is unrestricted, and individuals exposed in Rio not infrequently fall sick in Petropolis, but they never communicate the disease to others. This is also the experience of physicians in charge of hospitals located in healthy suburbs of infected towns. So long as the hospital and its vicinity remain uninfected, cases do not originate in its wards as a result of the admission of yellow fever cases, although these may be cared for by susceptible attendants and treated in the same wards with patients suffering from other diseases.

"In his report upon the camps established near Memphis in the epidemics of 1878 and 1879, Colonel Cameron makes the following statement: 'It was found necessary that the officer in authority should set an example of constant indifference to attack in order to appease, as far as possible, the constant anxiety of the population under his charge. Especially was this true in 1878, as depopulation went on slowly that year, and infected people poured daily into the camps from the more pestilential portions of the city. Very many reached camp with the fever on them, so that as many as seventeen persons fell victims in one night, not a few in their tents. In no instance, however, did they communicate the disease to their families or bed-fellows, as far as could be traced.'

"In the same epidemic (1878), Dr. Minor reports that over thirty cases were discovered among refugees in Cincinnati, O., and says: 'No physician or nurse contracted the disease, and in no instance did it exhibit any tendency to spread.' The same was true in Nashville the same year; twenty imported cases occurred in different parts of the city without any local cases resulting from them. Evidence of this kind could be extended to fill a volume; but sufficient has been presented to establish the statement made, and the reader may be referred to the 'proofs of non-contagion' in the second volume of the classical work of La Roche (pp. 236–566.)" [1]

Formerly many of those who denied that yellow fever could be transmitted by personal contagion assumed that it could not be transmitted, and ascribed outbreaks to local insanitary conditions, together with the favorable meteorological conditions recognized as essential for the development of an epidemic. These believers in the "local origin" of the disease denied the necessity for isolation of the sick and quarantine restrictions, while the "contagionists" insisted upon the exotic origin of the disease and its transmissibility by ships, persons, and fomites. That this latter view is correct is beyond question, although, as we have shown, the disease is not usually communicated by personal contact, and favorable external conditions are as essential for the development of an epidemic as is the introduction of the specific infectious agent.

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[1] Quoted from the writer's article on Yellow Fever in Wood's *Reference Handbook of the Medical Sciences*, vol. viii. p. 55.

As heretofore suggested, the yellow fever patient, like the patient with cholera or typhoid fever, probably carries "germs" in his intestine which are capable of abundant development outside of the body when local conditions are favorable. As to the specific germ, we have no exact information, inasmuch as all attempts to demonstrate its presence in the bodies of the sick or to isolate it from the excreta have been unsuccessful. But the conditions favorable for its development are well established.

Yellow fever is endemic at certain places upon the sea-coast of North and South America and the islands in the Gulf of Mexico, and from these places it is disseminated by human intercourse. Epidemics commonly develop as a result of the arrival from an infected locality of an individual who has been taken sick *en route* or after his arrival. But they may originate from the introduction of infected articles, independently of any imported case. The origin of several epidemics has been traced, with great probability, to the unloading of earth ballast from the vicinity of an infected city upon the wharves of a healthy seaport during the season favorable for the development of the disease.

As a rule, some time elapses after the introduction of a case or of "fomites" before the outbreak of a local epidemic. This interval varies according as local conditions are favorable or otherwise for the development of the infectious agent.

Yellow fever is essentially *a disease of the sea-coast*, and especially of large cities in an unsanitary condition, but when circumstances are favorable it may extend into the interior, following routes of travel, and especially navigable rivers.

It is, however, confined to the lower levels even in tropical or subtropical regions. In the Antilles the disease rarely prevails at an altitude above 700 feet. In Mexico the cities of Orizaba, Jalapa, and Puebla, which are more than 3000 feet above the sea level, have never suffered from the disease, although they have unrestricted communication with the infected seaport, Vera Cruz. In Spain, where several severe epidemics have occurred, the disease has rarely prevailed at an altitude above 1000 feet. The epidemic at Madrid (altitude 2000 feet), which occurred in 1878, was, however, an exception to this rule. In the United States a severe epidemic occurred at Chattanooga, Tenn., in 1878. This town has an altitude of 745 feet, which is the highest point at which the disease has prevailed in this country.

Temperature is an essential factor in determining the prevalence of yellow fever in those places where it is endemic and in the establishing of new centres of infection. Although the disease prevails to some extent throughout the year in the cities of Havana, Vera Cruz, and

Rio de Janeiro, it is especially prevalent during the hot season in these cities, and its epidemic extension occurs only in the summer months. The seasonal prevalence in the city of Havana is shown in the following table, compiled by Chaillé:[1]

Mortality from Yellow Fever in the City of Havana for Ten Years, 1870 to 1879, inclusive (Chaillé).

Month.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	Average of ten years.
January	6	18	20	32	7	16	24	8	26	11	17
February	4	23	13	23	4	16	24	9	13	13	14
March	4	12	4	27	18	32	29	11	5	6	15
April	6	34	4	37	22	34	33	8	28	13	24
May	14	91	13	127	85	32	103	16	33	40	57
June	66	201	68	378	172	142	292	143	184	237	188
July	112	234	68	416	361	187	675	249	304	475	328
August	201	138	70	127	416	144	250	285	374	417	242
September	91	72	59	35	186	102	97	234	179	148	120
October	77	55	38	28	91	109	42	185	106	44	78
November	49	51	85	5	42	105	31	150	33	31	60
December	35	42	73	9	21	82	19	76	34	9	40
Total	665	991	515	1244	1425	1001	1619	1374	1559	1444	

In places which have a mean winter temperature below 65° F. the disease, when introduced, cannot establish itself as an endemic. The development of an epidemic requires a temperature of 75° to 80° F., maintained for some time, and upon the approach of cool weather the progress of the disease is checked. When the temperature falls below the freezing point it is usually completely arrested, and, as a rule, the disease does not recur during the succeeding summer unless it is again introduced. Epidemics may terminate before the occurrence of cold weather simply because all susceptible persons in the infected area have suffered an attack of the disease. Under these circumstances the continued activity of the morbific element ("germ") is shown when "unacclimated" persons venture to visit the infected locality; and many lives have been sacrificed by the premature return of refugees to their homes in the belief that they could safely do so, as no new cases had recently occurred in the pest-stricken town.

Atmospheric moisture and precipitation influence the development of yellow fever epidemics, and in arid, desert regions the disease is unknown. But while a certain amount of atmospheric humidity and soil moisture is essential, the disease has sometimes committed its greatest ravages during unusually dry seasons. Heavy rains by purifying the atmosphere and washing away accumulations of filth may exercise a favorable influence upon the progress of an epidemic. The *trade winds* of the tropics, and strong sea-breezes in general, are beneficial from a sanitary point of view, and places exposed to their continuous action rarely suffer from the disease under consideration. They dilute and carry away the poisonous emanations from insanitary places, and refresh and invigorate those who inhabit localities exposed to their action.

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[1] *Report to the National Board of Health,* Washington, 1880.

The wind has little to do with the dissemination of the disease. This is shown by the fact that vessels which anchor some distance from the shore in the vicinity of infected places do not suffer from the disease so long as they are kept in a good sanitary condition and unacclimatized members of the crew are not permitted to go on shore, while vessels lying at the wharves are very liable to become infected.

The board of experts appointed by Congress to investigate the epidemic of 1878 arrived at the following conclusion: "We know of no instance, either from our own observations or from the published records of yellow fever, in which it has been established that the disease has been carried to any considerable distance by atmospheric currents or by any modes or vehicles of conveyance other than those connected with human traffic and travel."

SANITARY CONDITIONS.—When the infectious agent is introduced by the sick or by means of fomites to localities in the "yellow fever zone" during the season favorable for the epidemic prevalence of the disease, its propagation without doubt depends largely upon local insanitary conditions, and it is doubtful whether it could effect a lodgement in a clean and well paved city. Its epidemic prevalence in New York and Philadelphia during the latter part of the last and the early part of the present century was during a period when these cities were for the most part unpaved, unsewered, and unclean. And it is in similar localities in the cities now most subject to invasion that it usually first appears and most persistently remains. In Havana, Rio de Janeiro, and other endemic foci of the disease it is especially prevalent in low-lying, filthy districts with unpaved streets. Organic matter of animal origin in a state of decomposition appears to afford a favorable nidus for the germ, and the accumulation of fecal matter in exposed situations is favorable to the development of an epidemic. Reasons have already been given for the view that the excreta of the sick contain the specific infectious agent. Dr. Parkes, the English hygienist, maintained the fecal origin of the disease. He says: "To use a convenient phrase, yellow fever, like cholera and typhoid fever, is a fecal disease. And here we find the explanation of its localization in the West India barracks in the olden time. Round every barrack there were cesspits, often open to sun and air. Every evacuation of healthy and sick men was thrown into, perhaps, the same places."

One method by which infectious material may be transported from such exposed filth-beds to the stomach of individuals living in the vicinity has recently attracted considerable attention in connection with the propagation of cholera. This is through the agency of flies, which may come directly from a cesspool to the kitchen or dining-room, and there contaminate articles used for food or drink. In this connection, however, it is well to call attention to the fact that the epidemic prevalence of the disease has never been shown to depend upon the use of a contaminated water supply, as is the case in cholera and typhoid fever. In cities having a common water supply the disease is not generally diffused at the outset of an epidemic, but it extends rather slowly from certain infected foci to which it has been introduced in the first instance or subsequently.

BACTERIOLOGY.—We have seen that the development of a yellow fever epidemic depends upon conditions external to the human body relating to temperature, filth accumulation, etc., and in the present state of science we are justified in the inference that the specific infectious agent which multiplies in presence of such conditions is a living micro-organism of some kind. But the morphological and biological characters of this hypothetical germ have not yet been demonstrated. This assertion is based upon the personal investigations of the writer made in Brazil, in Cuba, in Mexico, and in the United States in accordance with an act of Congress (1887) authorizing such an investigation. In my report[1] of these investigations I have formulated my conclusions as follows:

"The most approved bacteriological methods fail to demonstrate the constant presence of any particular micro-organism in the blood and tissues of yellow fever cadavers.

"The micro-organisms which are sometimes obtained in cultures from the blood and tissues" (immediately after death) "are present in comparatively small numbers, and the one most frequently found (Bacillus coli communis) is present in the intestine of healthy individuals; consequently its occasional presence cannot have any etiological import. . . . .

"Having failed to demonstrate the presence of a specific germ in the blood and tissues, it seems probable that it is to be found in the alimentary canal, as is the case in cholera. But the extended researches made, and recorded in the present report, show that the contents of the intestine of yellow fever cases contain a great variety of bacilli, and not a nearly pure culture of a single species, as is the case in recent and typical cases of cholera.

"Comparatively few liquefying bacilli are found in the fæces discharged during life or in the intestinal contents collected soon after death from yellow fever cadavers. . . . .

"Some of the micro-organisms present in the dejecta of yellow fever patients, as shown by stained smear preparations, have not developed in the cultures made, either aërobic or anaërobic. One extremely slender, filiform bacillus, which can only be seen with high powers, and which is quite abundant in some of my preparations, has never been obtained in the cultures made, and no doubt there are others in the same category.

"That the yellow fever germ is strictly anërobic, or that it will only grow in a special nidus, may be inferred from certain facts relating to the extension of epidemics."

It may eventually be found that the micro-organism which produces this disease belongs to an entirely different group from the bacteria: we are disposed to believe, however, that it is an anaërobic bacillus which multiplies in the intestines or in fecal accumulations outside the body, and which produces a deadly toxin (toxalbumin?) to which the phenomena of the disease are due.

In view of the facts heretofore recorded and the conclusions reached as a result of experimental investigations it is evident that the dejecta of yellow fever patients should be regarded as infectious material, and should never be thrown into privy vaults or upon the soil until they have been completely disinfected.

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[1] *Report on the Etiology and Prevention of Yellow Fever*, Government Printing Office, Washington, 1890.

Susceptibility and Immunity.—When yellow fever prevails as an epidemic all persons exposed within the infected area who have not previously suffered an attack are liable to contract the disease. But there is considerable difference in the susceptibility of individuals, and the negro race is generally believed to be less susceptible than the white. This is manifested, however, by the comparatively mild character of the attack rather than by an immunity from the disease. According to La Roche, the mortality among the whites on the island of Jamaica was 102 per 1000, and among the blacks 8 per 1000; in the Bahamas the mortality of the whites was 59 per 1000, that of the blacks 5.6 per 1000. In the great epidemic of 1878 the negroes appear to have furnished a considerable proportion of the cases, and in certain localities the mortality among them was considerable. Thus at Brownsville (Tenn.) 162 cases with 21 deaths occurred among the colored population; at Chattanooga, in a total of 685 cases, 429 were colored and 256 white, while the mortality among the blacks was 46 and among the whites, 118; at Decatur (Ala.) 64 cases and 28 deaths occurred among the whites, and 186 cases with 21 deaths among the blacks. The natives of northern latitudes are generally believed to be more susceptible than those born in tropical or subtropical countries, and the mortality among the fair-skinned natives of the North is higher than among natives of Southern Europe. Blair, as a result of observations made in Guiana, says: "The lower the winter temperature in the native country of those attacked, the more severe was their sickness; so that, while the mortality among West Indians amounted to only 6.9 per cent. of the sick, it rose to 17.1 among the Italians and French, 19.3 among the English, 20.2 among the Germans and Dutch, and 27.7 among the Scandinavians and Russians."

The mortality among the indigenous races of the West Indies and of those parts of North and South America in which the disease prevails occasionally or habitually, and of Mongolians living in these regions, is also less than among the whites; but none of these races have an immunity from attack.

A single attack of yellow fever usually protects from subsequent attacks, especially if the individual continues to reside in one of the endemic foci of the disease. While second attacks are comparatively rare, and some authors of experience have asserted in positive terms (Blair and others) that they never occur, there is ample evidence that one attack is not always protective. Thus, "Dr. Jackson states that in Spain, during the epidemic of 1820, 20 well authenticated instances came within his knowledge of persons being attacked who had had the disease before." Dr. Wragg, speaking of the epidemic in Charleston in 1854, says: "Six of these were so well proved as to admit of no doubt on the subject. Some of the patients were identified as having gone through the fever in this (the Roper) hospital in 1852, throwing up black vomit on both occasions" (La Roche). Dr. Rush also observed second attacks in Philadelphia in persons who had suffered a comparatively mild first attack.

In localities such as Havana and Rio de Janeiro, where yellow fever has established itself as an endemic disease, the adult native population enjoys an immunity which is almost absolute, and has been supposed to be hereditary. This view, until recently, was generally accepted by physicians residing in these endemic foci of the disease. There is, however, accumulating evidence that the immunity enjoyed by "creoles" is not inherited, but results from a mild and usually unrecognized attack during infancy or childhood. Dowler, writing of the epidemic of 1853 in New Orleans, says: "Many creole children had, during the epidemic of 1853, a fever, a slight fever—yellow fever, if you please, known as such rather by the coexistence of the epidemic than from any severe symptoms among these children—a slight fever never yet described, having generally but one paroxysm, lasting from six hours to one, two, or three days, scarcely ever requiring medication. That a few of these cases acquired an alarming violence, and even proved fatal, is most true, most deplorable."

Hinemann writes with reference to Vera Cruz: "Until lately the physicians and people of Vera Cruz supported with fanaticism the dogma that natives were absolutely exempt from yellow fever. But the fearful epidemics of recent years (1875, 1877, 1878) have worked a change, for so many native children and adults suffered that the truth could no longer be denied that these do not enjoy an absolute immunity."

In Cuba the dogma that creoles are exempt from yellow fever did not withstand the searching investigation made by the Havana yellow fever commission of 1879.

In the epidemic of 1887 at Key West the children of "acclimated" Cubans, natives of Havana, born since the arrival of their parents at Key West, showed the same susceptibility to the disease as other children. The recent investigations of Guiteras also give strong support to the view that the immunity of adult creoles results from an unrecognized attack occurring during childhood. Blair, speaking of the epidemic in British Guiana (1851–54), says: "Infancy was one of the most favoring causes of the action of the yellow fever poison. The constitution of the new-born or young white creole was highly susceptible. He or she was truly in the category of new-comers."

The great susceptibility of new-comers who without previous "acclimatization" are exposed during the prevalence of an epidemic is generally recognized in those places where the disease is endemic; and, on the other hand, persons who have resided for some time in an infected locality seem to acquire a certain degree of immunity independently of an attack of the disease. The fact that foreigners may remain for years in Havana, in Rio de Janeiro, and other endemic foci of the disease without suffering an attack is well established. But those who have escaped for several years are liable to be attacked during a season of unusual epidemic prevalence. The disease is, however, less fatal in such cases than among unacclimatized strangers.

Owing to the immunity acquired in childhood or by long residence in the infected area, yellow fever is a disease of minor importance among the native population in cities where it is endemic. This is shown by the following figures: In the city of Rio Janeiro, which has a population of 400,000, the mortality from some of the principal causes of death in the year 1886, an epidemic year so far as yellow fever is concerned, was—from tuberculosis, 2077; diseases of the circulatory apparatus, 1458; diseases of the cerebro-spinal system, 1345; diseases of the digestive apparatus, 1097; malarial diseases, 1086; *yellow fever*, 1015. In the same year (1886) more than twice as many deaths among the civil population of Havana resulted from tuberculosis as from yellow fever. That the immunity enjoyed by the population of the infected cities mentioned is not due to climate, *per se*, is shown by the fact that country people living in the same latitude readily contract yellow fever when they visit these cities during the epidemic season; also by the fact that when the disease was first introduced to Rio Janeiro in 1849 the native population gave no evidence of immunity, and for several years the mortality among them was considerable.

The susceptibility of males and females probably does not differ materially, although a larger mortality occurs among males, because they more frequently and often recklessly visit infected localities, and because of the intemperate habits of some of those who fall victims to the disease—*e. g.* sailors and soldiers. A recent debauch is generally recognized as a predisposing cause.

PATHOLOGICAL ANATOMY.—An inspection of the exterior of the body of an individual who has recently succumbed to yellow fever furnishes indications which should at once arouse suspicion as to the nature of the disease, especially in localities where it is known to prevail. The integument presents an icteric hue which differs from the saffron yellow color of jaundice and is due to blood pigment. It resembles the color which is seen to follow a bruise causing an effusion of blood into the tissues, and is less intense and less uniformly distributed than the yellow produced by bile pigments. Moreover the depending portions of the body, as a result of hypostatic congestion and pressure, have a deeper coloration and are more or less livid and mottled. That this appearance is due to pressure and position is shown by the fact that when the body is placed upon the side or abdomen soon after death, the most dependent part still shows this livid and marbled appearance. The face often has a livid and turgescent appearance, like that of a person recently drowned, or the face and hands may appear cyanosed. The lips or gums are often soiled with dark blood as a result of passive hemorrhage during the last hours of life, and a little stream of black fluid may frequently be seen trickling from the corners of the mouth or nostrils. This is the so-called "black vomit," which flows from the distended stomach or is forced out by an accumulation of gas in the intestine. Cadaveric rigidity is established soon after death. In the warm latitudes where the disease habitually prevails putrefactive decomposition quickly occurs, and unless the autopsy is made within a few hours after the fatal termination of a case, postmortem changes are likely to complicate the pathological appearances resulting from the disease.

The *blood* in yellow fever presents no changes which can be recognized by a microscopical examination during the progress of the case or immediately after death, but there is a certain degree of disorganization of the red corpuscles in severe and fatal cases, as is shown by the yellow color of the serum from the presence of free hæmoglobin. This may be observed in blood drawn as early as the third or fourth day, but is much more pronounced in that obtained from the large vessels and cavities of the heart after death. The serum obtained from blisters in advanced cases also has a yellow color. That this is not due to bile pigments is shown by the chemical researches of Cunisset and others. Blood drawn during life does not coagulate readily, or the coagulum is soft and loose, and the blood in the heart and large vessels after death is usually fluid and dark colored. The cavities of the right side of the heart may, however, contain soft coagula, and the right ventricle sometimes contains a more or less decolorized fibrinous clot. The "disorganized" and diffluent condition of the blood has been supposed by some to account for the passive hemorrhages which are so characteristic of the disease. But it is evident that if the capillaries and larger vessels were intact no escape of blood could occur as a result of its loss of coagulability. The hemorrhagic tendency is rather to be ascribed to changes in the walls of the small vessels and capillaries which weaken their resistance to pressure; and several competent observers agree that the walls of these vessels undergo a fatty degeneration.

Upon removing the calvarium the *brain* and its *meninges* are usually found to give evidence of congestion. The pons and medulla are especially hyperæmic. The surface of the brain often presents little hemorrhagic points and its substance is tinted yellow. There is usually some effusion into the ventricles and in the subarachnoid space, the fluid being of yellow color and sometimes turbid. Schmidt of New Orleans has described certain changes in the sympathetic ganglia to which he attaches importance. These consist in a disappearance of the nuclei from most of the ganglion cells, and in a "peculiar fatty lustre" which they presented, even in specimens mounted in balsam.

The *lungs* occasionally contain hemorrhagic infarctions, and are hyperæmic, otherwise they present no evidence of pathological change.

The *heart* has been described by some authors as soft and friable. I have not observed this, and no evidence of fatty degeneration was found in slides mounted by Guiteras (1879), whose autopsies were made very promptly after death. On the other hand, Schmidt and Riddel believe that the muscular fibres undergo a fatty degeneration. The *pericardium* frequently contains a considerable quantity of yellow serum.

Upon opening the cavity of the abdomen the most important and characteristic pathological appearances will be found. The *stomach* almost always contains a considerable quantity of a grumous black fluid similar to that commonly ejected during the last hours of life—"black vomit." There is no mystery as to the nature of the pigment in this black fluid. It is undoubtedly blood pigment more or less changed by the acid secretions of the stomach. The writer has repeatedly verified the presence of numerous decolorized blood corpuscles by microscopical examination. These are often massed together in little clumps, and brownish pigment granules are seen attached to these masses or in their vicinity. The pigment is not dissolved in the fluid, but is present in the form of granules which are insoluble in water; consequently, the spectroscope fails to demonstrate the presence of blood pigment. But when the black matter is dissolved in acidified alcohol a positive result may be obtained. Freire and others have imagined that this black pigment is a product of the vital activities of some micro-organism. But this view is entirely without scientific foundation. By adding some drops of hydrochloric acid to blood diluted with water a dark fluid is obtained which does not differ in appearance from the black vomit ejected by yellow fever patients (Dantes). The mucous membrane of the stomach shows patches of congestion, and occasionally small red spots resembling ecchymoses, which, according to Schmidt, consist of "an unbroken network of minute vessels congested with blood and identical with the network of large capillaries which surrounds the aperture of the gastric glands." The congested patches present no uniformity, the number and extent differing in different cases. Some authors have supposed that the most important pathological changes in yellow fever occur in the stomach, and that the disease is essentially an infectious gastritis. Crevaux thinks that the most important lesion consists in a fatty degeneration of the cells which line the gastric glands and of the capillaries of the mucous membrane. In specimens obtained at some of my own autopsies in Havana, placed in alcohol very soon after death, there is evidence of inflammation in a certain proportion of the cases. This is shown by the presence of collections of leucocytes in the submucous coat. But this appears to be rather exceptional than otherwise.

The *small intestine*, and especially the ileum, often contains a black fluid similar to that found in the stomach or, more frequently, a grumous, black material which consists of mucus and blood pigment and is smeared over the mucous coat of the gut. This usually comes from the stomach, but in some cases is due to a passive hemorrhage from the mucous membrane of the intestine itself, which is sometimes uniformly red as a result of hyperæmia or may present arborescent patches of congestion similar to those seen in the stomach. The large intestine occasionally shows a like appearance, but is usually normal.

The *liver* presents the most constant and characteristic pathological changes. As a rule, it is of a pale yellow or brownish yellow color, like that of new leather in its various shades, and contains comparatively little blood. But it is sometimes livid and gorged with blood, presenting a dark blue or purple color. This is especially apt to be the case when death occurs after a very brief illness—two or three days. As the victims of chronic alcoholism are especially apt to succumb to an attack of yellow fever, evidence of interstitial hepatitis is not infrequently found associated with the lesions characteristic of yellow fever. The dimensions of the liver, except in comparatively rare cases in which it is gorged with blood, do not differ materially from the normal. The parenchyma is more or less friable and easily torn, owing to the fatty change in the cells. On section the liver tissue is found to be drier than normal and to present the "boxwood" or "new leather" color characteristic of the disease, unless death has occurred during the stage of hyperæmia, which probably usually precedes that of anæmia and fatty degeneration. The cells are not uniformly changed, but areas of greater or less extent are seen in which they are infiltrated with fat globules. These are of varying dimensions, and one or several may be contained in a single cell. The nuclei often remain intact in these cells infiltrated with fat, but, according to Schmidt, "a great number of nuclei may also undergo fatty degeneration." Not infrequently the central vein is surrounded by normal cells, while those cells about the periphery of the lobule contain many fat globules.

In two of the livers brought back from Havana by the Yellow Fever Commission of 1879, in which there were evidence of cirrhosis, Woodward found that, in addition to the fatty change described, "an abundant infiltration of leucocytes was observed, not merely in the abnormally developed interlobular connective tissue, but also in the parenchyma of the lobules." I have also found a rather extensive infiltration of leucocytes in two cases, and in one of these a veritable necrosis of the cells had occurred in limited areas in the vicinity of the infiltration. Councilman, who made a careful study of material obtained at my autopsies in Havana (1888, 1889) discovered a form of necrosis in the interior of the cells not previously described. He says: "The most interesting results were obtained from the examination of the liver. It has long been held that fatty degeneration of this organ was one of the most characteristic lesions of yellow fever, and it was found to a greater or less extent in all of the sections examined. It varied greatly in intensity in the different cases; in some comparatively large areas of liver tissue, which showed very little degeneration, were found; in others only here and there a few normal liver cells were seen. This lesion, however, does not seem to me to be the most important one of the organ. When sections of the liver are deeply stained with eosin and subsequently with a nuclear stain, either hæmotoxylin or methylene blue, a very peculiar appearance results. When such sections are examined with a low power the liver cells are found to be stained a faint reddish blue or purple color, the nuclei being a deep blue or purple. Among the liver cells or in place of them a great number of bodies stained intensely red with the eosin are found when examined with a high power. These bodies are found to differ entirely from the liver cells. They are sharply circumscribed, are highly refractive, and are composed of a perfectly hyaline mass containing numerous vacuoles. Their size varies greatly; in some cases they are no larger than a leucocyte, in others as large as two liver cells. They are found enclosed in liver cells otherwise perfectly normal, and in some cases they entirely take the place of these in the liver beam-work between the capillaries. In some cases examined they apparently made up the mass of the tissue, only here and there a portion of a liver cell or a nucleus of such being seen. Sometimes, especially where the liver tissue was most scanty, along with these definite circumscribed masses more or less granular material was found which stained in the same way. These bodies were generally round or more or less irregular in form. In some of the liver cells small hyaline masses staining in the same way were found which were not so sharply circumscribed as the larger bodies. They were found most abundantly in the cases where the fatty degeneration was most extreme, but the most striking pictures were obtained where the liver was least altered.

"In a few instances liver cells were found which only differed from the normal in being more coarsely granular, the granules staining with eosin, but not so distinctly as the eosin-staining bodies, and the nucleus stained more faintly blue than the nuclei of the surrounding liver cells. In most cases these bodies were without any nucleus; in others a nucleus was present. This always was at the periphery, and generally took the long irregular form of the nucleus of a wandering leucocyte. Polynuclear leucocytes were numerous in all the livers examined. In some cases there were well-defined groups of them in the capillaries and in the liver beam-work between, and as it seemed often in the red-stained bodies. In several specimens there were hemorrhages in the liver, large areas being occupied by red blood corpuscles, between which the red bodies were often seen. This peculiar condition of the liver is possibly made more clear by staining the sections deeply with picrocarmine. In sections so treated these bodies stain an intense bright yellow with the picro-acid. Concerning the nature of these bodies there can be little question. When first seen it was thought that they were probably some form of lower organism, possibly amœbæ, but a more extended study showed that this could not be so. Bodies in all respects similar to them were found in rapidly advancing cases of cirrhosis of the liver, in phosphorus-poisoning, and in other cases of rapid fatty degeneration, but they are particularly found in cases of acute yellow atrophy of the liver. Areas were found in sections from this which were very similar to the advanced cases of yellow fever liver. It must be considered that in yellow fever, along with the fatty degeneration, there is a necrosis of the liver cells which sometimes affects only portions of the cells, at others the entire cell. Almost every change leading up to the formation of these bodies could be seen. The exact relation of the fatty degeneration to the necrosis could not be determined. The necrotic masses were found both in intact liver cells and in those which had undergone fatty degeneration. In the latter cases it seemed probable that the necrosis preceded, or at least accompanied, the degeneration. If it only represented a necrosis of the small remnant of cell protoplasm between the fat drops, it is difficult to see how so large a body could be formed from this. When the necrotic masses were found in the liver cells they were nearly always at the periphery of the cell next to the capillary."[1]

The changes in the *kidneys* are those produced by an acute parenchymatous nephritis. The macroscopic examination does not reveal any marked variation from the normal appearance, except that when a fatal termination has occurred after a very brief illness they may be found hyperæmic and of a deep red color. The observations of Crevaux, Schmidt, and others indicate that there is always a brief period of congestion in advance of the changes in the renal epithelium. Small hemorrhagic foci are not infrequently seen beneath the capsule or in the cortical substance, and little globular hemorrhagic points have been observed on section which proved to be the distended capsules of the glomeruli.

In thin sections, properly prepared, the renal epithelium is found to have undergone degenerative changes to a greater or less extent, and in places complete degeneration has occurred. Sometimes whole bundles of tubes are denuded of their epithelium and are empty. These changes are most marked in the tubules of the labyrinth. Councilman describes the changes in the cells as follows: "The cells often contained larger and smaller fat drops, shown by the clear spaces remaining after they were dissolved out by the alcohol, but the principal change was a hyaline degeneration of the cells. The cells contained an immense number of clear hyaline granules which stained more brightly with eosin. In the dilated tubules there were large and smaller, generally round, masses of similar hyaline material." Besides these hyaline masses there are also granular infarctions of the tubules, and others in which there is a mixture of granular débris and hyaline material. These correspond with the granular and hyaline tube casts found in the urine of yellow fever patients. Again, there are infarctions of another kind which attracted the writer's attention early in his investigations, but the exact nature of which has not been determined. The peculiarity of these consists in their form and in the fact that they are deeply stained by the aniline colors. They are made up of disk-shaped masses, irregular lobate clumps, or amorphous fragments. Councilman speaks of this as "colloid material," and says it is found in the loops of Henle and the collecting tubules. The writer has elsewhere suggested that these infarctions, which are stained by the nuclear staining agents, may be made up of the nuclei of cells which have undergone the hyaline degeneration described by Councilman. Another unexplained object which is not infrequently seen in sections of the kidney has a crystalline appearance and an irregularly circular or lobate outline. These bodies are highly refractive, and are marked by lines of fracture radiating from the centre to the periphery. They do not stain with any of the reagents used in the preparation of sections for microscopical examination. Occasionally a considerable number of leucocytes may be seen in the tubules, and sometimes they contain red blood corpuscles. Councilman concludes his report of the examination of a series of sections which I submitted to him for examination, as follows: "The changes in both the liver and kidney appear to be due to a general toxæmia rather than to the local presence of infectious agents. They are diffuse, affecting the whole of the organs, and not small areas."

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[1] Quoted from the writer's *Report upon the Etiology and Prevention of Yellow Fever*, Washington, 1890, p. 152.

We have heretofore suggested that the phenomena of the disease are due to the action of a deadly toxin formed, probably, in the intestine. My experiments in Havana (1889) show that "the material obtained from the small intestine of yellow fever patients at autopsies made soon after death is very virulent when injected beneath the skin of guinea-pigs."[1] The examination of the liver and kidney for *micro-organisms* has given results which correspond with those obtained by the method of cultivation. In those cases in which my cultures made from blood or liver tissue, obtained as soon as possible after death, gave a positive result, I have usually found the same micro-organisms in thin sections of the same material. In my report, heretofore referred to, I say: "A summary of these results shows that I have obtained micro-organisms in my aërobic cultures as follows: In blood from the heart, 4 times in 19 cases; in the liver or kidney, or both, 13 times in 43 cases."

Dr. Councilman, who carefully examined a series of thin sections submitted to him by me, says: "Bacteria of some sort were found in 28 of the 130 sections examined; of these, 18 were sections of the liver, 8 of the kidney, and 1 each of stomach and lymph gland. There was nothing in their form or relation to the tissue that would lead one to suppose that their presence was other than accidental. In no case could any connection be shown between their presence and the essential lesions of the disease. In no case was there any lesion in the surrounding tissue which could be attributed to their presence. Among the bacilli were some which agreed in form with the colon bacillus."

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[1] *Report on Etiology and Prevention of Yellow Fever*, Washington, 1890, p. 131.

INCUBATION.—The period of incubation is comparatively short, and probably never exceeds five days. Instances of attacks occurring inside of twenty-four hours after exposure are well authenticated. Several authors have insisted that the period of incubation may be prolonged to two weeks or more, but we believe this to be an error based upon a misinterpretation of the facts observed. Thus when a case develops on a ship some time after leaving port, it does not follow that it resulted from exposure while on shore. On the contrary, such a case is usually quickly followed by others, and is evidence that the ship is infected.

SYMPTOMS.—There are no constant or well defined *premonitory symptoms* in advance of an attack of yellow fever, but in a certain proportion of the cases the individual complains of loss of appetite, lassitude, a tendency to perspire upon slight exertion, giddiness or slight headache, and indisposition to make any mental or physical exertion for two or three days before the initial chill, which usually inaugurates an attack. In other cases there is not the slightest intimation of ill health up to the moment of the sudden seizure. This often occurs at night or in the early morning after an uninterrupted sleep. It may also occur during the day while the individual is engaged in his usual occupations. Out of 225 cases in the Roper Hospital, Charleston, observed by Wragg during the epidemic of 1854, the attack was without premonitory symptoms in 92, and in the remainder there was more or less malaise, etc. in advance of the attack.

Although the attack is commonly inaugurated by a decided *chill* or by a slight sensation of coldness, this is sometimes absent, especially in mild cases occurring in the tropics. In certain grave forms of the disease, also, the outset of the attack is insidious and without any noticeable chilly sensation. The temperature is already above the normal, as shown by a thermometer placed in the mouth or axilla, when the patient is suffering from the initial rigor. Accompanying the chill or, in its absence, with the access of fever, there is apt to be more or less *cephalalgia,* which is usually located in the frontal or supraorbital region. The eyeballs also are painful, and there is frequently considerable photophobia. The outset of the attack is also usually accompanied by severe *pain in the loins* and in the calves of the legs, which may continue after the febrile stage of the disease is fully developed. As the chill passes off the temperature rapidly rises; the *face* becomes flushed or of a congested and swollen appearance; the *eyes* are fiery red or shining and suffused; the *skin* becomes dry and hot; and in nervous patients there are great restlessness and jactitation.

The symptoms connected with the onset of the attack as above stated evidently present no features which are peculiar to the disease under consideration, which has, however, a well characterized clinical history when a complete and typical case is considered. In such a case, ending in recovery, we have three tolerably well marked periods: First, a *febrile stage,* which consists of a single paroxysm, lasting usually from forty-eight hours to four or five days, and in which the acme of temperature is reached early in the attack—usually on the first day. Second, the *stage of calm,* which follows defervescence and is marked by great depression of the vital powers, with a slow pulse and sometimes a subnormal temperature. The temperature may, however, remain a degree or two above the normal throughout this stage. Third, the *period of convalescence,* during which the vital forces reassert themselves, and the patient often passes quickly from a condition of extreme danger to one of comparative comfort and safety. In severe cases, however, the stage of calm is usually followed by a reactionary fever of irregular duration which has a more or less remittent character.

Numerous *varieties* of the disease have been described by authors, but yellow fever presents the same clinical features in all parts of the world where it prevails and in different epidemics. The so-called varieties for the most part represent different degrees of severity or depend upon complications and individual peculiarities. Bérenger-Féraud, who had an extended experience in the French Antilles, names the following varieties of the graver forms of the disease: (*a*) ordinary forms, including the gastric, adynamic, ataxic, congestive, and typhoid forms; (*b*) rare forms, including the hyperæsthetic, gangrenous, algid or choleraic, and hydrophobic. In some epidemics death has been known to occur within a few hours of the first manifestations of the disease. These rapidly fatal attacks are classified by French authors as *sidérante.* They are usually algid, congestive, or apoplectic in form, and are most likely to occur in the victims of chronic alcoholism, whose organs have undergone degenerative changes, and are consequently less able to resist the action of the deadly toxin of yellow fever.

The severity of the disease differs greatly in different epidemics. This depends partly upon the character of the population in the invaded area and partly upon local and meteorological conditions. When the population consists largely of negroes or of the creole residents of semitropical countries, the number of cases of the more fatal varieties above mentioned will be comparatively small. Not infrequently, also, the earlier cases in an epidemic are comparatively mild, the poison seeming to gain in activity as the epidemic progresses. Probably in this as in other infectious diseases the severity of an attack depends to some extent upon the dose of the infectious agent introduced into the system at the time of exposure, and this is influenced by conditions which favor its rapid development in the infected localities, especially by accumulations of organic material of animal origin, by heat, and by moisture.

In an account of the clinical history of yellow fever the *temperature* of the body is of prime importance, both as regards diagnosis and prognosis. The acme of temperature is commonly reached within a few hours of the onset of the attack, and rarely later than the evening of the third day. From this time, in uncomplicated cases, the temperature line is a descending one, interrupted sometimes by a slight evening exacerbation, until defervescence occurs, usually in from three to five days. At the end of this *single febrile paroxysm* the temperature, during the succeeding period of depression, may be normal or subnormal, or occasionally a degree or more above the normal. The initial paroxysm is sometimes divided into two or more distinct periods of from two to four days' duration by a more or less complete remission of brief duration, but this is so rarely the case that it does not call for any modification of the general statement that the disease under consideration is a continued fever of a single paroxysm.

"In an analysis of 192 cases recorded by Faget, Jones, and myself the acme of temperature was reached on the first day in 102, on the second in 54, on the third in 33, and on the fourth in 3. The highest temperature recorded by Faget was 107.2° F. Thornton, in a total of 143 cases occurring at Memphis, noted a temperature of 108° F. in a single instance. With this exception, 106.5° F. was the highest temperature recorded by him. In my own observations 106° F. has been the highest temperature noted. The temperature often rises rapidly just before death, and a very high post-mortem temperature (108° F. to 110° F.) is a common phenomenon."[1]

The typical temperature curve may be disturbed by visceral congestions, indiscretions in diet, moving the patient—as from shipboard to hospital—and by excessive fright or grief. The same causes may induce *a relapse* after the termination of the initial paroxysm, as a result of which all the phenomena which characterize this may be repeated, although in non-fatal cases the duration of the febrile movement is usually less.

At the outset of the attack *the pulse* is usually full and strong, the number of pulsations being, as a rule, not more than 100 to 110 per minute. The force and rapidity diminish in a notable manner as the disease progresses, and this early failure in the strength and rapidity of the heart's action, even while the febrile movement is still at its height, is a feature of the disease which, as pointed out by Faget, is of diagnostic importance. During the period of depression—"stage of calm"—which follows the febrile paroxysm the pulse is very compressible and slow, the number of beats falling not infrequently to 40 per minute, and in exceptional cases even as low as 30. This feebleness of the heart's action during the second stage of the disease at a time when the patient often imagines that he is on the high road to recovery, inasmuch as all of his pains and uncomfortable sensations have disappeared, is a very characteristic feature of yellow fever, and one which indicates to the skilled physician a critical condition calling for careful treatment.

The *tongue* presents nothing which is characteristic. Usually it is moist, and becomes quickly coated with a white coating, except at the margins, which remain red. It differs from the tongue of the malarial fevers in being, usually, narrow and pointed, instead of broad and flabby, as is the rule in these diseases. As the disease advances the tongue may become dry and the coating assume a brownish color. In protracted cases it is likely to be very foul and loaded with sordes.

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[1] Quoted from my article in *Reference Handbook of the Medical Sciences*, vol. viii. p. 61.

At the outset of the attack the *face* is flushed or congested and swollen; sometimes in plethoric subjects it may be of a dusky violet color: this, with the deep red suffusion of the eyes which is commonly present in severe cases, together with the absence of any eruption, forms a striking feature of the first period of the disease. The countenance may be expressive of anxiety and pain, but is often dull and apathetic in appearance. Later, in fatal cases, the eyes often become sunken, the eyelids ecchymosed, the brows contracted, and the features shrunken, or the face may be bloated and flabby. In mild cases the hyperæmia of the conjunctivæ and flushing of the face are of brief duration; in more severe cases they often last through the febrile stage of the disease; in rapidly fatal cases the eyes may remain deeply injected throughout. A faint yellowish tinge of the conjunctivæ may usually be recognized by the third or fourth day; this becomes more intense as the disease progresses, and often lasts after convalescence is fairly established.

The skin is sometimes hot and dry throughout the febrile stage; more frequently it soon becomes moist, and free perspiration is readily induced by warm drinks and covering with blankets. During the second stage the skin is usually cool and moist, and when death occurs during this period of depression it is often preceded by a clammy sweat and coldness of the general surface of the body. In exceptional cases the skin remains hot and dry, and the temperature elevated up to the time of the fatal termination, which may be less than forty-eight hours from the inauguration of the attack.

A peculiar odor given off from the surface of yellow fever patients has been recognized by numerous physicians who have had experience in the treatment of this disease, but attempts to describe it have not been very successful. Rush compared it to the "washings from a gun," and Jackson says it is "sickly and faint, and not unlike the smell of a fish-market."

The *yellow color of the skin* which has given the disease the name by which it is generally known among English-speaking people is not always present, or may be so slight as to be recognized with difficulty. In severe cases, however, it is usually seen toward the end of the febrile stage, and becomes more intense during the "stage of calm," lasting until convalescence is fully established and even longer. The color of the skin varies from a faint yellow tint to a deep orange or saffron yellow, or it may occasionally be a bronze or mahogany color. This yellow color is developed at a time when the urine is albuminous and free from bile, and without doubt is due to the presence of blood pigment in the liquor sanguinis and not to bile pigments. But in certain cases jaundice from bile pigments is developed at the end of the second period or during convalescence, and is accompanied by the presence of an abundance of bile pigments in the urine. In these cases the yellow color of the skin is more intense and lasts longer. The characteristic yellow discoloration, which coincides with the period during which hemorrhages are likely to occur, may first be recognized by a slight yellow tinge of the conjunctivæ, of the face, and of the skin over the superficial blood-vessels. In fatal cases the cadaver presents a well marked yellow discoloration, especially the dependent portions subject to pressure, even when this was not noticeable during the last hours of life.

Bérenger-Féraud has noticed an erythematous eruption about the scrotum in yellow fever patients which he believes to be a characteristic feature of the disease. Other eruptions mentioned by various authors as occasionally observed are erythematous patches about the knees and elbows, pustules about the mouth and elsewhere, petechiæ, furuncles, etc.

The *urine* is scanty even during the first period of the disease, and in fatal cases complete suppression occurs some time before death. The presence of *albumin* is so constant a symptom as to be properly considered a pathognomonic feature of the disease. In mild cases only a trace may be found during a brief period, but when frequent and careful tests are made it will seldom, if ever, prove to be entirely absent. In cases of moderate severity it is usually present in considerable quantity, especially during the second stage of the disease, when the amount of urine secreted falls to a minimum. In severe cases the coagulated albumin precipitated by heat or nitric acid frequently occupies one half the contents of the test-tube or even more than this. The deposit is usually sufficiently abundant after the second day to leave no doubt as to its character, and increases in quantity during the second period of the disease. The amount present is to some extent an index of the gravity of the attack.

In a series of 16 non-fatal cases in which the writer (1875) made careful observations upon the quantity and specific gravity of the urine the following averages were obtained:

	Fluidounces.	Spec. grav.
First day		1023
Second day	11.5	1025
Third day	16	1028
Fourth day	18	1022
Fifth day	19	1022
Sixth day	20	1022
Seventh day	22	1021
Eighth day	22	1019
Ninth day	23	1016
Tenth day	28	1013
Eleventh day	37	1011
Twelfth day	41	1013

It will be noticed that the amount of urine secreted gradually increased and the specific gravity diminished after the third day. When these two factors are considered together, it will be seen that the total solids excreted were about the same from the third to the eleventh day. The amount of *urea* eliminated by the kidneys is in inverse proportion to the severity of the attack, and corresponds closely with the quantity of urine. This is always considerably less than normal, and in severe non-fatal cases often falls to a few ounces in the twenty-four hours, while in fatal cases complete suppression usually occurs in from a few hours to twenty-four hours before death. According to Cuniset, the amount of *uric acid*, although reduced, is not diminished to the same extent as the urea. The urine, as a rule, has a decidedly acid reaction. Occasionally it contains blood as a result of renal or vesical hemorrhage. In non-fatal cases bile pigments commonly make their appearance in the urine about the time that convalescence is established.

There is usually complete *anorexia* during the febrile stage, and in severe cases this may last through the following period of depression; but in mild cases the appetite usually returns with the disappearance of the fever, and the patient often at once enters upon convalescence. In cases of moderate severity, although the desire for food may return, the stomach is not able to retain anything but the simplest forms of liquid nourishment, and any indulgence of the appetite is likely to cause vomiting and to lead to serious consequences.

Thirst is constant during the febrile stage, and in a less degree during the succeeding period of depression, especially when there is copious and frequent vomiting.

Vomiting frequently occurs during the febrile period, the vomited matters consisting for the most part of fluids ingested, containing in suspension flocculi of mucus from the stomach; occasionally the fluid ejected at the outset of an attack has a yellow color from the presence of bile. The vomited matters almost always have an acid reaction. In cases which run a favorable course vomiting ceases, with the other distressing symptoms, at the termination of the febrile paroxysm; but in severe and fatal cases it is likely to return after an interval of twenty-four hours or more, during which the patient complains of a feeling of weight and discomfort in the epigastric region. This gastric distress may be slightly relieved for a brief period after the act of vomiting, although often nothing is thrown up but a few spoonfuls of a clear acid fluid. In other cases the amount of fluid ejected is considerable; in severe and fatal cases this presents, in a more or less marked degree, the characters of "black vomit." At first the black pigment is usually seen in the form of a few little flocculi suspended in a transparent fluid; in severe and fatal cases the number of these flocculi increases, and the vomited matters may present the appearance known as "coffee-ground vomit," or they may be so numerous as to give the fluid a uniformly black color when first ejected. But upon standing this black vomit usually separates into two portions, the lower containing the black matter in suspension, while above this a transparent liquid is seen. Under the microscope the little pigmented masses are seen, by transmitted light, to have a yellowish brown color, and a careful examination shows that they contain decolorized blood corpuscles and granular leucocytes as well as the brownish pigment granules. In short, there is no doubt that the appearance of black vomit depends upon the escape of blood from the gastric mucous membrane into the cavity of the stomach. Occasionally there is a more active hemorrhage and the patient throws up pure blood. Recovery sometimes occurs after the characteristic black vomit has been ejected, although this is generally recognized as a very grave symptom, presaging death. The name "vomito" given to the disease in Spanish-American countries has reference to the dreaded black vomit, but is scarcely appropriate, inasmuch as a majority of the cases ending in recovery do not present this symptom.

That the gastric mucous membrane is seriously implicated in the disease under consideration is shown by a marked tenderness on pressure over the epigastrium, by the constant feeling of discomfort and pain in the epigastric region in severe cases, and by the tendency to passive hemorrhage above referred to.

The *bowels* at the outset of an attack are apt to be somewhat constipated; later they often remain torpid, but easily moved by a mild cathartic or purgative enema; or there may be more or less diarrhœa during the second period of the disease. In fatal cases the discharges from the bowels are often similar in character to the black fluid ejected from the stomach, and are of the same nature. This may come from the stomach or may be due to a passive hemorrhage from the mucous membrane of the small intestine. Occasionally there is more active hemorrhage and a discharge of pure blood from the bowels. Hemorrhages may also occur from the mouth, nose, bladder, or uterus, or even from the eyes and ears in rare cases. Epistaxis and oozing of blood from the gums, tongue, or lips is the most frequent form of hemorrhage after that from the gastric mucous membrane.

The symptoms connected with the *nervous system* are those which might be expected in a disease characterized by a febrile paroxysm and subsequent stage of depression. At the outset, when the fever is at its height, there is usually severe frontal headache and rhachalgia; the patient is apt to be wakeful throughout the first stage, or his sleep is fitful and disturbed by distressing dreams; his mind is in a state of tension, and he is anxious, watchful, and easily excited; but, as a rule, there is no active delirium. Certain cases are characterized by sluggishness of mental action, apathy, and indifference; in others there are hallucinations and more or less incoherency of ideas; occasionally there is active delirium, which may call for restraint in order to keep the patient in bed, but the intellect often remains unclouded throughout even in severe and fatal cases; more frequently the fatal termination is preceded by a torpid condition of the mind with a disposition to somnolence, gradually passing into complete coma. Occasionally death is preceded by convulsions, and tetanic rigidity of a more or less complete character has been noted as a rare occurrence. There is frequently great restlessness, with deep sighing respiration, often spasmodic in character. The *respiration* is accelerated during the febrile stage, but the respiratory apparatus is not implicated in this disease.

In severe cases convalescence is often slow, and may be complicated by the occurrence of parotitis, abscesses, furuncles, hepatitis, or diarrhœa. In mild cases, on the contrary, the patient frequently is out of bed and ready to resume his usual occupations within a day or two after the termination of the febrile paroxysm. Army experience shows that those attacked are rarely able to resume their duties in a less time than ten days or a fortnight from the date of attack, and that a considerable number must be retained in hospital a month or more, on account of the debility following a severe attack.

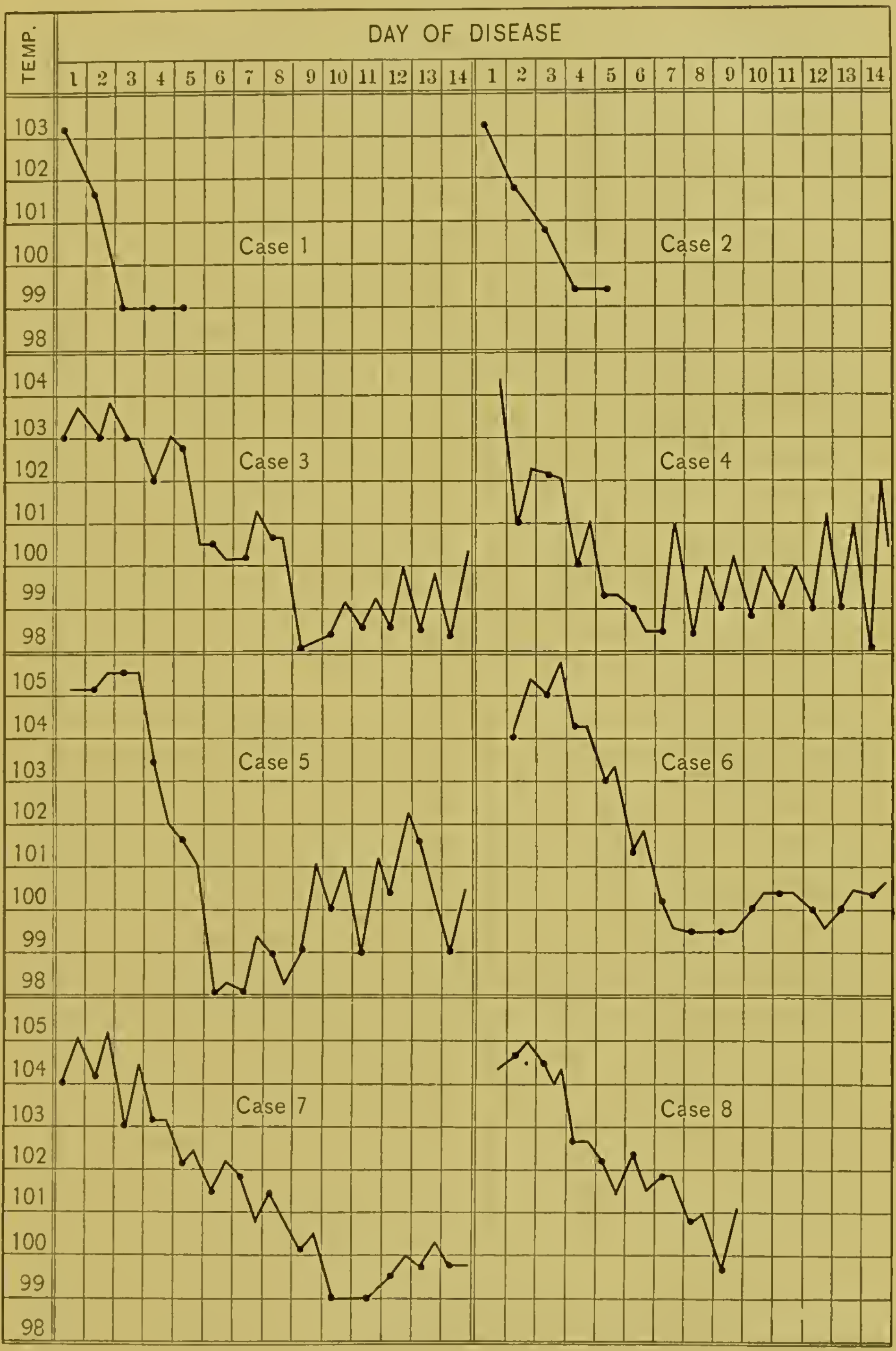
Relapses are not infrequent as a result of some indiscretion committed during the early period of apparent convalescence or during the second stage of the disease. Relapses are said to occur occasionally as late as from two to four weeks after the termination of the primary febrile paroxysm.

DIAGNOSIS.—A prompt diagnosis, especially of the first cases in an epidemic, is often a matter of very great importance. But notwithstanding the well marked clinical features of the disease and its characteristic pathological lesions, the diagnosis of early cases has often been a matter of dispute, even after the autopsy. This may be due to inexperience on the part of physicians encountering it for the first time, or to mistaken ideas as to the nature of the disease among those who have seen much of it, but have failed to recognize its specific character and to differentiate it from certain fevers of malarial origin encountered in tropical or subtropical regions. When a case of yellow fever is improperly diagnosed as "bilious fever" or "remittent fever," and after the administration of several full doses of quinine at the end of three or four days the temperature falls to the normal, the diagnosis is supposed to be confirmed, and this defervescence, which is a characteristic feature of the disease, is supposed to have resulted from appropriate medication. If the case results fatally, the prejudice which so often goes with a positive but mistaken diagnosis sometimes leads to the assertion that the case was one of "pernicious malarial fever." Formerly a considerable number of the physicians in our Southern seaport cities maintained that yellow fever and the malarial fevers are closely allied if not identical diseases, and under this idea the milder cases in an epidemic were often called "malarial fever," and only those in which black vomit and a yellow discoloration of the skin completed the clinical picture of a severe case were recognized as yellow fever. Similar mistakes in diagnosis occur not infrequently at the present day in some of the Spanish-American seaports where this disease is most prevalent.

The fact that the early cases in an epidemic are sometimes of a mild character has led to much confusion in attempts to trace the origin of certain outbreaks. These early cases having been called by some other name, it is not until a typical severe or fatal case occurs that a diagnosis of yellow fever is made: this being considered the first case, the origin of the epidemic which follows remains a mystery, or it is supposed to have originated *de novo* as a result of insanitary conditions which it is not difficult to discover.

There is nothing in the symptoms at the outset of an attack of yellow fever which will justify a positive diagnosis in the absence of a prevailing epidemic. The chill followed by fever, with flushed face, injected conjunctivæ, full pulse, frontal headache, and lumbar pains, might mean smallpox or some other eruptive fever or an attack of one of the malarial fevers. But the eruptive fevers will soon be ruled out by the absence of an eruption; intermittent fever, by the brief duration of the paroxysm and speedy return to a nearly normal state of health; remittent fever after two or three days, by the difference in the temperature curve and the absence of albumin from the urine. It is true that in certain severe forms of malarial fever the urine may contain albumin, but this is not an early symptom in these cases, and does not greatly detract from the diagnostic value of this symptom. In yellow fever, even when the attack is of a mild character, a distinct deposit of albumin will usually be obtained by the third or fourth day, and in cases of moderate severity the precipitate will be so abundant as to justify a positive diagnosis as early as this (third or fourth day) when this symptom is considered in connection with the temperature, the pulse, etc. Or if doubt still exists, the symptoms which characterize the second stage of the disease will serve to differentiate it from those forms of malarial fever for which it has most often been mistaken. As an aid to diagnosis I introduce here several temperature charts of typical cases which show the characteristic features of the febrile paroxysm :

FIG. 31.



Cases Represented by Temperature Charts.

No. 1. Mild case of brief duration; boy, aged three years (New Orleans, 1873); reported by Dr. T. C. Faget.

No. 2. Mild case of brief duration; young female (New Orleans, 1873); reported by Dr. Touatre.

No. 3. Protracted mild case; male, aged twenty-seven years (Fort Barrancas, Fla., 1873); reported by Dr. Sternberg.

No. 4. Typical case of moderate severity; male, aged thirty-one years (Fort Barrancas, Fla., 1873); reported by Dr. Sternberg.

No. 5. Typical severe case; male, aged twenty-seven (Fort Barrancas, Fla., 1873); reported by Dr. Sternberg.

No. 6. Typical severe case; male, aged twenty-seven years (New Orleans, 1873); reported by Dr. Layton.

No. 7. Protracted severe case ending in recovery; reported by Bérenger-Féraud (French Antilles).

No. 8. Fatal case; death on ninth day; male, aged twenty-eight (Fort Barrancas, Fla., 1873); reported by Dr. Sternberg.

It is true that certain cases of malarial fever exhibit a temperature curve which presents considerable similarity to that of yellow fever, but as a rule "remittent fever" has a series of febrile paroxysms separated by more or less complete remissions, instead of a single paroxysm of several days' duration ending in defervescence, complete or nearly so.

As regards the presence of albumin in the urine, the following observations by Donnet, made during an epidemic in Jamaica, are of interest: In 61 cases, carefully studied, albumin was found for the first time on the first day in 2; on the second day in 11; on the third day in 19; on the fourth day in 14; on the fifth day in 6; on the sixth day in 4; on the seventh day in 4; on the eighth day in 1.

The desquamative nephritis to which the presence of albumin is due is also shown by the presence of numerous granular casts in the urine, which may usually be found as early as the third or fourth day.

If a diagnosis has not been made before, the symptoms which characterize the second period of the disease should serve to differentiate it from all forms of "malarial fever," properly so called. The cool and usually moist skin, the abnormally slow, soft pulse, the gastric distress and pain or pressure in the epigastrium, the yellow tinge of the conjunctivæ, and the albuminous urine in a patient whose temperature is normal or subnormal, following a febrile paroxysm such as is represented by our temperature charts, certainly furnish a clinical picture which should be recognized. But experience shows that it frequently is not recognized, and cases which present the additional feature of black vomit have been called "hemorrhagic malarial fever," "pernicious fever," etc.

It is true that severe cases do not always present the typical course which we have described: the temperature may remain a degree or two above the normal during the stage of depression; the skin may be dry, and a reactionary fever of a remittent character may quickly follow the initial paroxysm; but we still have the albuminous urine, the abnormally slow pulse, the yellow tinge of the conjunctivæ, and in certain cases the hemorrhages so common in this disease—black vomit, etc. In addition to this there are other differences in symptoms which have more or less value. The tongue in yellow fever is usually narrow and pointed, with red margins, and is apt to be tremulous; it is often comparatively clean at the outset, and rarely presents the thick yellowish or brownish coating seen in remittent fever. The tongue in the malarial fevers is usually broad and flabby, and marked upon its margins by indentations made by the teeth. The yellow color of the skin in bilious remittent fever is due to a staining by bile pigments, and does not differ from that of simple jaundice; it is more intense in color and more persistent than the yellowish tint seen in yellow fever: it should be remembered, however, that a true biliary jaundice may be developed in non-fatal cases of yellow fever during the period of convalescence.

The spleen is not involved in yellow fever, while in the malarial fevers it is more or less swollen and tender. Vomiting of bilious matter is a common symptom in severe forms of malarial fever; in yellow fever it is rare, and only occurs, if at all, at the outset of the attack; the vomited matters later are transparent and colorless. In yellow fever the amount of uric acid excreted is diminished, while, according to La Roche, it is notably increased in remittent fever. Suppression of urine is a common feature in fatal cases of yellow fever; it rarely occurs in bilious remittent fever.

That form of fever which the French denominate *fièvre bilieuse mélanurique*, and which has been called "hemorrhagic malarial fever" by certain American authors, presents features which differ essentially from those of yellow fever. These are well stated by Bérenger-Féraud, as follows:

"Prolonged residence in a malarial country is the most powerful, and, indeed, indispensable, predisposing cause.

"The disease is always preceded by numerous attacks of malarial fever, simple at first, then more and more complicated, and taking on in general more and more of a bilious aspect, producing a very decided anæmia.

"Icterus appears at the outset of the attack, and is never wanting; it gives from the commencement and throughout the attack a uniform yellow color to the patient, varying from greenish yellow to a decided yellow ochre.

"The march is intermittent or remittent from the first, and the pulse, urine, and vomiting follow very exactly the variations of temperature.

"The vomiting is bilious, of a decided green color; it is a constant symptom at the outset of an attack, and is arrested with the termination of one attack to reappear with the next.

"After the first, or febrile, period the vomiting continues, but preserves the same characters; it stains linen a bright green, and when collected in a basin it appears transparent and is of a beautiful emerald green or olive color.

"The tongue is moist, broad, covered at first with a heavy white fur, which soon receives a greenish tint from the vomited matters. The tongue is not red, either upon its tip or edges; it remains broad, heavily coated, and moist to the end of the malady.

"The urine is black from the commencement, and its color is characteristic, so that the patient himself is struck with it. It is usually abundant and frequently passed, and only has the melanuric aspect during the attack."

Dengue, as regards its epidemic prevalence, somewhat resembles yellow fever. It is an acute, infectious disease, which prevails in those latitudes which are most subject to invasion by yellow fever during the season most favorable for the epidemic extension of this disease. It, also, is characterized by a febrile stage of comparatively short duration, but the characteristic features of yellow fever are absent—albuminous urine, stage of depression, hemorrhages, etc.—and it is accompanied by severe arthritic and muscular pains which have led to its being called "breakbone fever." Moreover, there is usually a well marked eruption, resembling that of scarlet fever and commencing on the third day, and after the termination of the initial febrile paroxysm a second commonly occurs, accompanied by a rubeoloid eruption which often ends in desquamation of the cuticle. There is a wide difference also in the comparative fatality of the two diseases. Dengue, although the most distressing to the patient, is by far the least serious in its results, and rarely is the cause of death.

Certain circumstances connected with the personal history of the patient will aid greatly in establishing an early diagnosis. A stranger in Havana or Rio de Janeiro during the epidemic season, who has an attack of fever presenting the symptoms described as attending the febrile stage of this disease, and whose urine is found at the end of two or three days to be albuminous, is sent without hesitation to the yellow fever hospital. And a person arriving at one of our seaports from an infected locality, presenting similar symptoms, would be isolated and placed under careful observation, even if the diagnosis was not at once established. But in a similar case, with no history of exposure in an infected locality, there is often doubt as to the diagnosis or an absolute denial of the possibility that the disease is yellow fever.

When we hear of the prevalence of a "malignant form of malarial fever" in a seaport city located within the limits of yellow fever invasion, we are always justified in suspecting that the disease is in fact yellow fever. For malignant and fatal forms of malarial fever belong to the country rather than to the city, and cases of this kind do not occur in groups among the residents of a restricted area within the limits of a city. Even when a localized epidemic does not appear to be "malignant" in character, especially when it occurs among a native creole or negro population, the fact of its prevalence in a large town or city is opposed to the view that it is of malarial origin—properly so called—and it is more likely to be yellow fever than anything else, unless, indeed, it should prove to be dengue.

Prognosis.—Yellow fever is an extremely fatal disease, and even in apparently mild cases a guarded prognosis should be made, as they may suddenly assume a serious character. The prognosis is especially unfavorable in the case of plethoric persons and in those of intemperate habits. It is more favorable in women and children than in men—more favorable in the case of native creoles and negroes, in warm latitudes where the disease prevails, than for recently arrived strangers from more northern latitudes.

The writer's personal observations and studies have led him to attach great value to the temperature observations made during the first two or three days of the attack as a guide in prognosis. When the temperature of the body, as shown by a clinical thermometer placed in the mouth or axilla, does not go above 103° to 103½° F. during the first forty-eight hours, a favorable result may usually be anticipated. If, on the contrary, the temperature reaches 105° or more, the case must be considered a severe one and the prognosis is grave. This is shown by the following table, compiled by the writer some years since from a series of 269 cases recorded by various authors, in which careful temperature observations had been made:

Cases in which the temperature was	No. of cases.	No. of deaths.	Percentage of deaths to cases.
107° and above	13	13	100
106°-107°	9	9	100
105°-106°	36	22	61
104°-105°	80	24	30
103°-104°	87	6	7, nearly
102°-103°	29	0	
101°-102°	15	0	
Total	269	74	27.5

The amount of urine secreted and the quantity of albumin it contains will also furnish an important prognostic indication. However favorable the symptoms may appear otherwise, if the urinary secretion is scanty and it is heavily loaded with albumin, the case is a grave one. On the other hand, great depression, black vomit, or hemorrhages are not necessarily fatal symptoms, and hopes of recovery may be entertained if the urinary secretion is satisfactory in amount and the quantity of albumin small. Great distress and tenderness in the epigastric region, with frequent vomiting, are unfavorable, as is great restlessness with sighing respiration or delirium. The early appearance of the hæmatogenous jaundice characteristic of the disease is not favorable.

The *mortality* differs greatly in different epidemics, and, as heretofore pointed out, depends largely upon the character of the exposed population. Where a considerable proportion of those attacked are children, native creoles, or negroes, the mortality is comparatively low —from 5 to 10 per cent. But among unacclimated male adults the mortality is rarely less than 20 and frequently above 50 per cent. The mortality in the great epidemics which occurred in Philadelphia at the end of the last and commencement of the present century was from 20 to 80 per cent. The mortality in the seaman's hospital at Georgetown (Demerara) in 1838 was 19.5 per cent. (Blair). The mortality at Vera Cruz during the seven years ending 1881 was 41 per cent. in the hospital for women and 41.48 per cent. in the hospital for men (Molina). In 1855 the mortality among the Spanish stroops in Cuba was 24.31 per cent. In 1873 the mortality in Rio de Janeiro was 23.3 per cent. In the epidemic of 1878, 27,000 cases and 4600 deaths occurred in the city of New Orleans (17 per cent.); 18,500 cases and 5000 deaths in Memphis (27 per cent.); at Vicksburg 5000 cases and 872 deaths (17 per cent.) — 2000 cases and 231 deaths among the colored population. These figures are from the report of a "Board of Experts" appointed by Congress to investigate the epidemic. The total number of cases and deaths collected by the Board, as occurring in 132 cities and towns in the infected area, was—cases 74,265; deaths 15,934 (besides 254 "reported without any report for the number of cases corresponding thereto"). This gives a mortality of a little over 21 per cent. for the entire epidemic. These figures, however, are only approximate, and no doubt the mortality rate would be reduced somewhat if all of the cases had been reported. It must be remembered also that the figures relate to both the white and colored populations, and that in many localities the negro population was equal to or in excess of the white population, as many of the latter class deserted their homes and sought refuge in healthy places farther north. Bemiss has given the following table showing the mortality according to age, among whites only, during this epidemic. The figures include the cases treated in private practice by four of the leading practitioners of the city of New Orleans :

Age.	Cases.	Deaths.	Per cent.
Under 5 years of age	206	26	12.67
From 5 to 10 years of age	233	20	8.58
From 10 to 20 years of age	183	9	4.9
From 20 to 40 years of age	232	39	16.7
From 40 to 60 years of age	47	6	12.7
From 60 to 80 years of age	4	2	50.0
Total	905	102	11.28

The day of death, as ascertained in 1059 fatal cases occurring in the French Antilles, is given by Bérenger-Féraud as follows : On the second day of sickness, 16 (1.5 per cent.) ; on the third day, 56 (5.3 per cent.) ; on the fourth day, 141 (13.4 per cent.) ; on the fifth day, 165 (15.7 per cent.) ; on the sixth day, 177 (16.9 per cent.) ; on the seventh day, 151 (14.3 per cent.) ; on the eighth day, 89 (8.5 per cent.) ; on the ninth day, 42 (3.9 per cent.) ; on the tenth day 35 (3.3 per cent.) ; on the eleventh day, 28 (2.6 per cent.) ; on the twelfth day, 34 (3.2 per cent.) ; on the thirteenth day, 25 (2.3 per cent.) ; on the fourteenth day, 21 (1.9 per cent.) ; on the fifteenth day, 8 (0.7 per cent.) ; on the sixteenth day, 7 (0.6 per cent.) ; on the seventeenth day, 13 (1.2 per cent.) ; on the eighteenth day, 6 ; nineteenth day, 6 ; twentieth day, 7 ; twenty-first day, 3 ; twenty-second day, 2 ; twenty-third day, 5 ; twenty-fourth day, 3 ; twenty-fifth day, 3 ; twenty-sixth day, 5 ; twenty-seventh day, 1 ; twenty-eighth day, 1 ; twenty-ninth day, 2 ; thirtieth day, 1 ; thirty-first day, 3 ; thirty-second day, 1 ; thirty-third day, 1 ; thirty-sixth day, 1. Out of the total number of deaths, 67 per cent. occurred during the first week and 82 per cent. during the first ten days of sickness. This corresponds closely with the results obtained by Surgeon Clements as regards 111 fatal cases occurring in the U. S. Army. Of these, 73 per cent. died during the first week and 82 per cent. during the first ten days.

TREATMENT.—All attempts to "cure" yellow fever by a specific treatment have been unsuccessful, and those physicians who have had most experience in the treatment of the disease generally agree that active medication, except for the purpose of meeting symptomatic indications, is mischievous. But it is possible that a specific treatment may yet be found, and further efforts should be made in this direction. Reasoning from analogy, it seems probable that the immunity which results from an attack of yellow fever is due to the presence of an antitoxin in the body fluids of the immune individual. And if this antitoxin could be utilized for the protection of exposed individuals or for the cure of those already attacked, its specific power might be manifested. But in the present state of knowledge there are serious difficulties in the way of testing the possible efficacy of such a specific mode of treatment. The specific infectious agent not having been demonstrated, and no one of the lower animals having been shown to be susceptible to infection, the only method which suggests itself for obtaining a supply of antitoxin is to tap the veins of an immune person for the purpose of obtaining blood serum to inject into the yellow fever patient. It is to be hoped that the experiment will be made at as early a date as possible, as the result would be of great scientific interest, and if favorable some method of more general utility might be discovered.

The idea that yellow fever is closely allied to the malarial fevers, which at one time was entertained by many physicians in regions subject to invasion, led to the attempt to abort the disease by the use of quinine in large doses. This experiment has been fully tried, and the treatment abandoned by most physicians of experience. Some, however, still think that a large dose of quinine (20 to 30 grains), given at the outset of the attack, has a favorable effect in modifying the severity of the febrile paroxysm and allaying nervous excitement. On the other hand, it is generally admitted that it sometimes induces cerebral congestion, and that a repetition of the dose may lead to unpleasant resnlts. Blair, who had an extended experience in the British West Indies, was in the habit of giving 20 grains of calomel and 25 grains of quinine at the outset of an attack, and in certain cases the dose was repeated. Dr. Porcher of Charleston approves of Blair's treatment so far as the first dose is concerned, but protests against its repetition. The amelioration of the symptoms which has been ascribed to this dose may be due in part to the antipyretic action of the quinine, but the free movement of the bowels usually induced by the calomel is entitled to at least a portion of the credit. It must be remembered also that the natural tendency of the disease is in the direction of a more or less prompt defervescence, and that the acme of febrile action, with its accompanying headache, pain in the loins, etc., is reached very soon after the inauguration of the attack. This amelioration of the symptoms attending the onset of the disease has no doubt often been improperly ascribed to the medicine administered, and the novice in the treatment of this disease is apt to congratulate himself upon the success of his treatment when the patient is in reality in the greatest danger—a danger which may be the greater as a result of over-active medication, by which the sensitive stomach is apt to be disturbed, the weak heart still further enfeebled, and the inflamed kidneys taxed beyond their power of resistance.

In the days of "antiphlogistic treatment" *emetics* were considered an important element in this treatment, and it was part of the routine to administer them at the outset of every case. This is still the practice with certain of the South American physicians. When the stomach contains undigested and fermenting material which causes nausea and distress, it is well to aid the efforts of nature by the administration of a simple emetic, otherwise it is not likely to do any good, and we do not approve of its routine use. *Purga-*

tives are generally believed to be useful at the outset of an attack, and most physicians commence the treatment by giving some medicine to promptly unload the bowels. Opinions differ as to the best form of cathartic medicine, but preference is given by many to a full dose of oleum ricini. On account of its non-irritating properties and prompt action it is a favorite in our own Southern cities, in the West Indies, and in Brazil. From two to four ounces are commonly given to an adult in a single dose. Experience shows that this is not excessive and that it has a prompt and favorable action. Some physicians prefer a mercurial, followed, if necessary, by a saline cathartic, and calomel is still the favorite with many. One reason for promptly emptying the *primæ viæ* is found in the fact that later the administration of cathartic medicine is likely to do harm by inducing vomiting difficult to control, and by increasing the depression which follows the febrile paroxysm. If it seems desirable to move the bowels after the second day of the disease, this had better be done by a purgative enema.

In the present state of knowledge a carefully managed *symptomatic treatment* will give the best results attainable and will do much toward reducing the mortality. We have pointed out the fact, in speaking of prognosis, that the temperature of the body, as shown by the clinical thermometer, is a fair index of the severity of the attack. It does not follow from this that the high temperature in severe cases is, *per se*, a cause of danger. If this were true, the evident indication would be to keep down the temperature by means of cold baths or antipyretic medicines. The intensity of the pathogenic action of the specific poison is indicated by the height and duration of the febrile movement, but we do not neutralize the pathogenic action when we reduce the temperature of the body. In the malarial fevers the temperature frequently rises to a higher point in cases which are not attended with any special danger. Nevertheless, it is desirable that this symptom—high temperature—should receive appropriate treatment, and a reduction of the febrile heat is usually attended with an amelioration of other more or less distressing symptoms—thirst, headache, sleeplessness, jactitation, etc.

The use of the cold bath is not to be recommended, unless it should be at the very outset in a case presenting an unusually high temperature with evidence of cerebral congestion. The tepid bath is better, but the most judicious and experienced practitioners in yellow fever regions agree that it is better not to disturb the patient to the extent necessary in administering frequent baths, and that after the first twenty-four hours, at least, they had better be omitted. The object in view may be accomplished with less disturbance to the patient by frequently sponging the hands, arms, and chest with cold water or with an evaporating lotion. Bérenger-Féraud recommends a mixture of 1 part of "aromatic alcohol" with 3 parts of water. Porcher advises the "assiduous and protracted application of ice-cold water to the head, hands, and arms as long as they are abnormally hot." Some practitioners are afraid of cold water and prefer to sponge the surface with tepid water. In our judgment, cold water and evaporating lotions may safely be used as applications to the head and for sponging the surface so long as the skin is hot and dry and the temperature elevated. When, however, the febrile stage is approaching its termination, it will be prudent to discontinue the sponging of the surface or to use tepid instead of cold water, on account of the great tendency to visceral congestions at this time. A hot mustard foot-bath is very commonly administered at the outset of the attack in domestic practice and by many physicians of experience. This may be repeated several times during the first twenty-four hours, and often induces a free perspiration, with relief of the headache and other distressing symptoms which occur at this time. The usual procedure is to have the patient sit upon the edge of his bed with a blanket wrapped around him and his feet and legs immersed in a bucket of water as hot as he can bear and containing a liberal quantity of mustard flour.

Bérenger-Féraud recommends the use of large enemata of cold water as an antipyretic measure. These may be frequently repeated, and are said to be quite harmless. Cold enemata have also been recommended for the relief of the congested and inflamed kidneys.

The knowledge that exposure to cool currents of air or a sudden fall in the external temperature is dangerous for yellow fever patients on account of the visceral congestions which are likely to be induced by such exposure—especially of the kidneys—has led many physicians to refrain from the use of cold lotions to the surface as an antipyretic measure, and by some the use of cold drinks is denied. This we believe to be a mistake, and the excessive use of blankets and hot drinks to induce perspiration may cause great discomfort to the poor patient without any corresponding benefit. When the febrile stage is approaching its termination, and during the stage of depression which follows, exposure to cold currents of air or a sudden fall in the external temperature, not compensated by artificial heat or a sufficient supply of bed-covering, may be fatal. But when there is considerable fever the patient should be lightly covered, care being taken, however, to protect him from draughts. If the skin is hot and dry, warm aromatic drinks may be given to promote perspiration, but it is a mistake to suppose that the course of the disease can be arrested or the deadly poison eliminated by maintaining a free perspiration; and when the patient is loaded down with blankets, the profuse perspiration which is often induced by this treatment does not materially reduce the body heat. *Antipyrine* has been given for its sedative and antipyretic effect, and is considered useful by some of those physicians who have had an opportunity to test its value. We should be disposed to administer it with caution and during the acme of febrile heat only—preferably at night, with a view to securing rest.

The use of arterial sedatives in small but repeated doses is approved by many experienced physicians: they may reduce the febrile action to some extent. *Aconite* may be given in combination with some mild diaphoretic during the first day or two; later, *digitalis* will be preferable on account of the tendency to heart failure. Bemiss says: "We have seen digitalis produce unquestionably good effect in mitigating fever, and have often administered it in doses of thirty to sixty drops of the tincture every third or fourth hour. It is best to give it in solutions of acetate of ammonia or potash." We should prefer to give it, in proper doses, with a solution of sodium bicarbonate in ice-cold water, administered as recommended by the writer in 1887.

Bicarbonate of soda has frequently been prescribed as an occasional *tives* are generally believed to be useful at the outset of an attack, and most physicians commence the treatment by giving some medicine to promptly unload the bowels. Opinions differ as to the best form of cathartic medicine, but preference is given by many to a full dose of oleum ricini. On account of its non-irritating properties and prompt action it is a favorite in our own Southern cities, in the West Indies, and in Brazil. From two to four ounces are commonly given to an adult in a single dose. Experience shows that this is not excessive and that it has a prompt and favorable action. Some physicians prefer a mercurial, followed, if necessary, by a saline cathartic, and calomel is still the favorite with many. One reason for promptly emptying the *primæ viæ* is found in the fact that later the administration of cathartic medicine is likely to do harm by inducing vomiting difficult to control, and by increasing the depression which follows the febrile paroxysm. If it seems desirable to move the bowels after the second day of the disease, this had better be done by a purgative enema.

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The use of the cold bath is not to be recommended, unless it should be at the very outset in a case presenting an unusually high temperature with evidence of cerebral congestion. The tepid bath is better, but the most judicious and experienced practitioners in yellow fever regions agree that it is better not to disturb the patient to the extent necessary in administering frequent baths, and that after the first twenty-four hours, at least, they had better be omitted. The object in view may be accomplished with less disturbance to the patient by frequently sponging the hands, arms, and chest with cold water or with an evaporating lotion. Bérenger-Féraud recommends a mixture of 1 part of "aromatic alcohol" with 3 parts of water. Porcher advises the "assiduous and protracted application of ice-cold water to the head, hands, and arms as long as they are abnormally hot." Some practitioners are afraid of cold water and prefer to sponge the surface with tepid water. In our judgment, cold water and evaporating lotions may safely be used as applications to the head and for sponging the surface so long as the skin is hot and dry and the temperature elevated. When, however, the febrile stage is approaching its termination, it will be prudent to discontinue the sponging of the surface or to use tepid instead of cold water, on account of the great tendency to visceral congestions at this time. A hot mustard foot-bath is very commonly administered at the outset of the attack in domestic practice and by many physicians of experience. This may be repeated several times during the first twenty-four hours, and often induces a free perspiration, with relief of the headache and other distressing symptoms which occur at this time. The usual procedure is to have the patient sit upon the edge of his bed with a blanket wrapped around him and his feet and legs immersed in a bucket of water as hot as he can bear and containing a liberal quantity of mustard flour.

Bérenger-Féraud recommends the use of large enemata of cold water as an antipyretic measure. These may be frequently repeated, and are said to be quite harmless. Cold enemata have also been recommended for the relief of the congested and inflamed kidneys.

The knowledge that exposure to cool currents of air or a sudden fall in the external temperature is dangerous for yellow fever patients on account of the visceral congestions which are likely to be induced by such exposure—especially of the kidneys—has led many physicians to refrain from the use of cold lotions to the surface as an antipyretic measure, and by some the use of cold drinks is denied. This we believe to be a mistake, and the excessive use of blankets and hot drinks to induce perspiration may cause great discomfort to the poor patient without any corresponding benefit. When the febrile stage is approaching its termination, and during the stage of depression which follows, exposure to cold currents of air or a sudden fall in the external temperature, not compensated by artificial heat or a sufficient supply of bed-covering, may be fatal. But when there is considerable fever the patient should be lightly covered, care being taken, however, to protect him from draughts. If the skin is hot and dry, warm aromatic drinks may be given to promote perspiration, but it is a mistake to suppose that the course of the disease can be arrested or the deadly poison eliminated by maintaining a free perspiration; and when the patient is loaded down with blankets, the profuse perspiration which is often induced by this treatment does not materially reduce the body heat. *Antipyrine* has been given for its sedative and antipyretic effect, and is considered useful by some of those physicians who have had an opportunity to test its value. We should be disposed to administer it with caution and during the acme of febrile heat only—preferably at night, with a view to securing rest.

The use of arterial sedatives in small but repeated doses is approved by many experienced physicians: they may reduce the febrile action to some extent. *Aconite* may be given in combination with some mild diaphoretic during the first day or two; later, *digitalis* will be preferable on account of the tendency to heart failure. Bemiss says: "We have seen digitalis produce unquestionably good effect in mitigating fever, and have often administered it in doses of thirty to sixty drops of the tincture every third or fourth hour. It is best to give it in solutions of acetate of ammonia or potash." We should prefer to give it, in proper doses, with a solution of sodium bicarbonate in ice-cold water, administered as recommended by the writer in 1887.

Bicarbonate of soda has frequently been prescribed as an occasional dose to neutralize the acid secretions of the stomach and to allay vomiting, but in the treatment above referred to the writer proposed, by the systematic administration of this salt, to neutralize the acid secretions from the outset, and thus to prevent, if possible, the nausea and vomiting which are so frequently distressing features of the disease. An alkaline treatment seemed to be indicated also by the highly acid condition of the urine, and it was hoped that it might have a favorable action on the kidneys. And on theoretical grounds it was thought that it might be well to administer at the same time the powerful antiseptic, mercuric chloride, in a minute and perfectly safe dose. Accordingly the following prescription was made:

℞. Bicarbonate of soda,	10.	(150 gr.).
Bichloride of mercury,	0.02	($\frac{1}{3}$ gr.).
Pure water,	1000.	(1 qt.).

M. Sig. 50 cc. (3 tablespoonfuls) every hour; to be given ice-cold.

Another object in view was to give a moderate quantity of ice-cold water at regular intervals, as this would be less likely to induce vomiting than larger amounts taken at the patient's option, and if absorbed would quench thirst better than larger quantities quickly rejected. I have had no personal experience in the treatment of yellow fever since this plan was suggested, but have received very favorable reports as to its value from various sources.

The treatment referred to has been tested by a number of physicians in the United States, in Cuba, and in Brazil, and I have had reports of 374 cases treated by ten physicians. Of these, 301 were whites, with a mortality of 7.3 per cent. and 73 cases blacks, with no mortality.

During the last epidemic at Jacksonville, Florida (1888), Sollace Mitchell treated 106 cases in the "Sand Hills Hospital" with 5 deaths—a mortality of 4.7 per cent. Of the 106 cases, 79 were whites, and of this number 73 were adult males. All of the deaths occurred among these, and the mortality among this class, considered separately, was 6.8 per cent.

La Guardia and Martinez in 1889 treated 44 cases in the Mercedes Hospital, Havana, with a mortality of 15.9 per cent. They say: "We have observed the following facts: The patients have offered a notable gastric tolerance during the medication; when treated from the first day vomiting has rarely occurred. The secretion of urine has always been considerable; even in the grave cases, when death occurred, they did not die anuric." Whether this treatment is still in use in the Mercedes Hospital and elsewhere in the city of Havana I am not informed, but the evidence published is certainly sufficient to justify a more extended trial. To what extent the small amount of mercuric chloride added to the formula is concerned in the favorable results reported I am unable to determine. This salt remains in solution in presence of sodium bicarbonate, but would be precipitated by potassium carbonate, which salt is also contraindicated in a disease in which there is a tendency to uræmic poisoning.

The addition of tincture of digitalis in suitable doses to the formula given might prove to be an advantage, but this can only be determined by carefully conducted clinical experiments. The administration of the ice-cold alkaline mixture at regular intervals, with or without the addition of one of the agents mentioned, appears to us to be a rational feature in the symptomatic treatment of the disease, and, as stated, is supported by favorable clinical evidence.

It is very desirable to prevent vomiting, inasmuch as the attempt to arrest it by medicines administered *per os* is usually a failure. Morphia given hypodermically suggests itself, but experience shows that this is a dangerous remedy, and only very minute doses are tolerated. Blair has seen stupor, prostration, and complete narcotism follow the administration of one tenth of a grain. We agree with him that it should be placed in the *index expurgatorius* so far as yellow fever is concerned.

Diuretics appear to be indicated on account of the scanty secretion of urine, but experience teaches that they are of little value, and that it is better to relieve the strain upon the hyperæmic and inflamed kidneys by diaphoretics and revulsants than to attempt to stimulate them to greater activity. When there is a tendency to suppression the application of large mustard poultices to the loins and the use of cold water enemata, together with measures appropriate to maintain a free transpiration by the skin, will be more likely to give relief than any diuretic medicine. After complete suppression has occurred no method of treatment is likely to be of any avail. Where the skin is hot and dry and the urinary secretion scanty, it might be worth while to administer a hypodermic injection of the muriate of pilocarpin (0.008 to 0.016 gm. = $\frac{1}{8}$ to $\frac{1}{4}$ grain). Hebersmith reports that when given in this way the dose mentioned produces a profuse perspiration with reduction of temperature.

Cerebral congestion is best relieved by cold applications to the head and *sinapisms* applied to the extremities. The feeling of weight and distress in the epigastric region, attended with nausea and due to hyperæmia of the gastric mucous membrane, also calls for the local application of cold—best secured by swallowing bits of ice or small quantities of ice-cold water, which may be charged with CO_2—and for revulsion to the surface by sinapisms applied to the epigastrium. These often give great relief, and are to be preferred to vesicants, which have no special advantage over sinapisms for the relief of the symptoms referred to, while the blistered surface gives much distress to the patient after it has ceased to do any good as a revulsive.

Stimulants are of the greatest utility in the second stage of the disease to sustain the feeble heart. They are rarely required before the fourth day, and should be given in small amounts, so as not to provoke vomiting. A little iced champagne will often be retained when the stomach rejects everything else, or brandy given ice-cold and with the addition of very little, if any, water, may be given in teaspoonful doses at short intervals. Later, when the patient enters upon convalescence, milk punch, English ale, or a sound wine may be given in liberal quantities. Blair prefers Rhine wine, and says: "When of good quality it is retained when everything else is rejected, and is universally liked by the patients. The happy effect of the judicious use of stimulants is shown not only by increased force and rapidity of the heart's action, but frequently by a relief of the distressing nervous phenomena often present during the stage of depression—sighing respiration, sleeplessness, jactitation, hiccough. There is a tendency to syncope during the second stage of the disease, which is especially manifest during the latter part of the night, when the powers of nature seem to be at the lowest ebb. This is often fatal, especially when the nurse or physician is not at hand to administer the stimulant which is so essential for the rescue of the patient at this critical moment."

Hemorrhage from the nose, stomach (black vomit), or bowels will often resist all treatment. An effort should be made to arrest it by the administration of ergotin by the hypodermic method, as some authors have reported favorable results from this treatment.

During convalescence, which is often protracted after severe attacks, tonics will be found useful, and especially the salts of quinine, strychnine and iron, either separately or in combination.

The *alimentation* in cases of yellow fever requires special attention. The stomach for some days is not in a condition to digest any food: during the first part of the febrile stage the patient usually has no desire for food, nor should any be given him. In mild cases there will often be a demand for food as soon as the fever subsides, but great caution must be exercised in complying with this demand. At first only the simplest forms of liquid nourishment should be permitted, and milk or chicken broth will usually be found the most acceptable to the patient and the least apt to disturb the stomach. In severe cases with much gastric irritability the milk should be mixed with lime-water and given at first in quantities not exceeding a tablespoonful, at intervals of an hour or two. If this is not retained, nutritive enemata should be administered, and the stomach should be given a further period of complete rest. When liquid food is retained and assimilated, it should be given in moderate quantities at intervals of two or three hours for a couple of days in mild cases, and for a longer time in those of a more serious nature, after which the simplest forms of solid food may be cautiously given. It should be constantly borne in mind, however, that premature indulgence in solid food is a frequent cause of relapse, and that relapses are extremely fatal.

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